

Hurricane and Severe Storm Sentinel (HS3) Mission

HS3 2013-08-20 Flight Report: GLOBALHAWK AV-6 mission to SAL and remnants of Erin

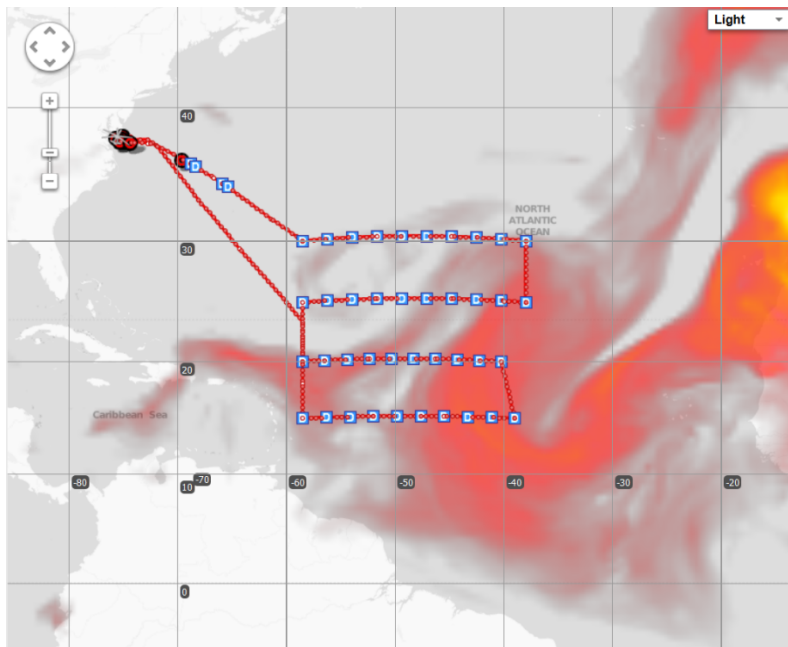
Flight Scientists:

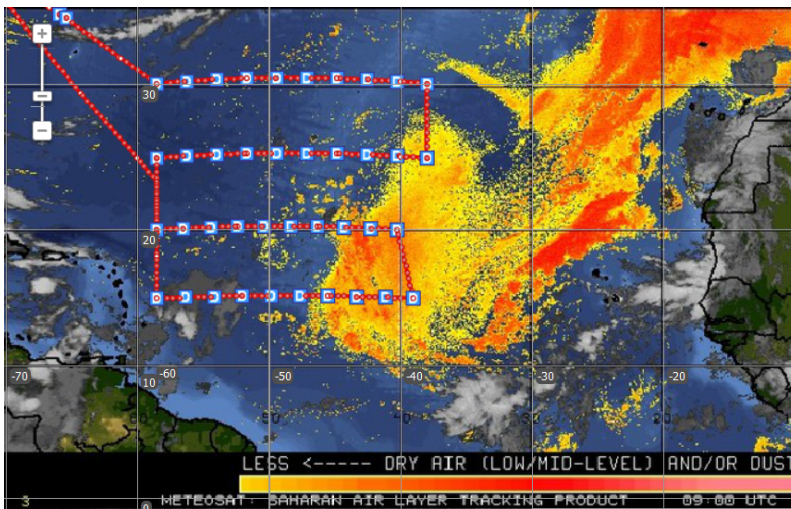
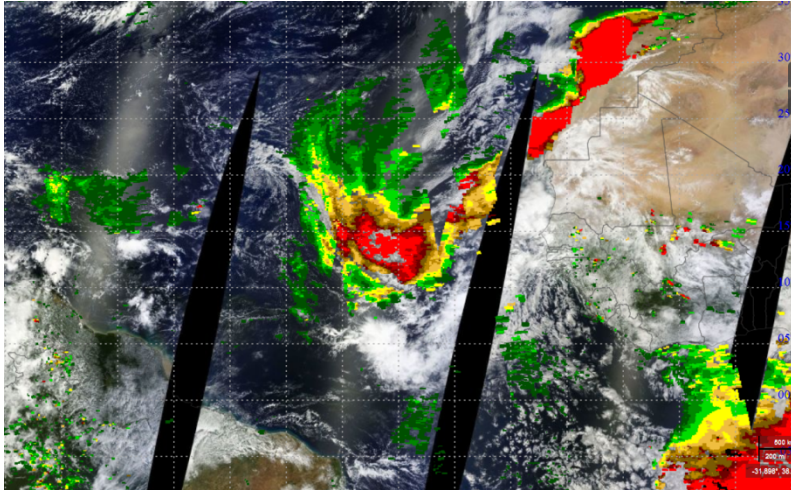
Shift 1 (0800-1700 UT): Scott Braun/Anthony Didlake/Amber Emory

Shift 2 (1600-0100 UT): Paul Newman

Shift 3 (0000-0900 UT): Jon Zawislak/Steve Guimond/Dan Cecil

Mission goal: Lawnmower pattern covering the remnants of Tropical Storm Erin and the leading edge of a significant dust outbreak. The flight pattern is overlaid on the GEOS-5 dust forecast (00Z 20 AUG run, 10-hr forecast, valid at 10Z 20 Aug) and a MODIS Aerosol Optical Depth image from Aug. 19 is shown in the second image below. The remnants of Erin can be seen just ahead and toward the northern end of the dust plume, and is composed of mostly low-level clouds. The goal of the flight is to sample the vertical structure of the environment of Erin's remnants as well as the leading edge of the SAL surge by having flight legs that are roughly normal to the SAL "front".





GOES SAL product for 09Z Aug 20 shows SAL air mass entering lawnmower region, about 2.5 hours prior to takeoff. Erin cannot be seen in the image due to its low clouds, but is positioned just ahead of the leading edge of the orange region near 18deg N, -48deg W.

1134 Engine Start

Anthony had problems importing waypoints into the drawing tool from Excel. The problem resulted from an extra blank line at the end of the list. So if having trouble, make sure no blank lines in the list. We have also noticed a problem exporting points from the drawing tool. When we choose CSV (Deg Min Condensed, Long/Lat), it exports the wrong numbers as if it is still lat/long. So -46deg long, 21deg lat gets written out as S46, E21.

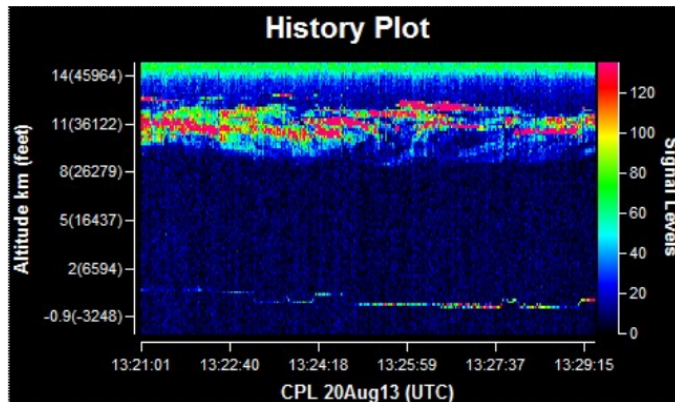
Had trouble with the GH showing up in MTS. Had to clear the cash. Make sure to refresh windows afterward in order to get everything working properly.

0830 Takeoff delayed because a King Air is landing on runway 04 (our runway, but opposite direction!).

0836 Beginning taxi to runway.

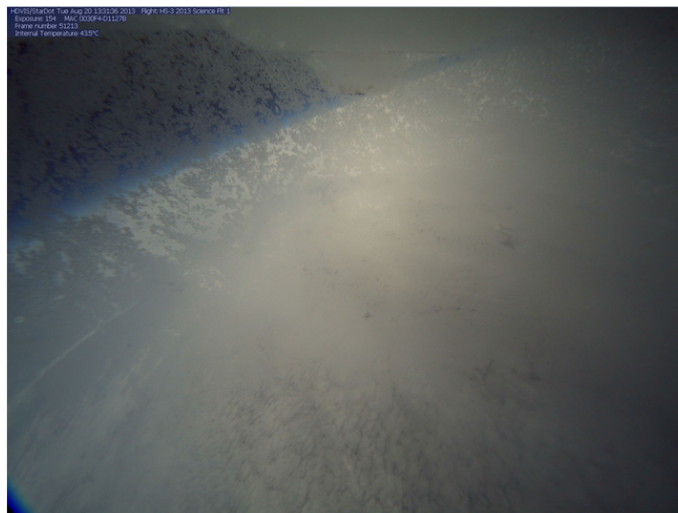
0841 Takeoff. First takeoff of a GH using GHOC-E!

CPL appears to be working well after their wire repair. See image below. CPL is seeing high-level cirrus as we climb in the warning area.



1331 UTC Leaving test-track area. Heading southeast.

HDVIS camera still showing condensation on the glass.



1423 Dropsonde successfully loaded.

1424 Had to hold dropsonde due to air traffic. Air traffic may also be an issue during the first east-west leg.

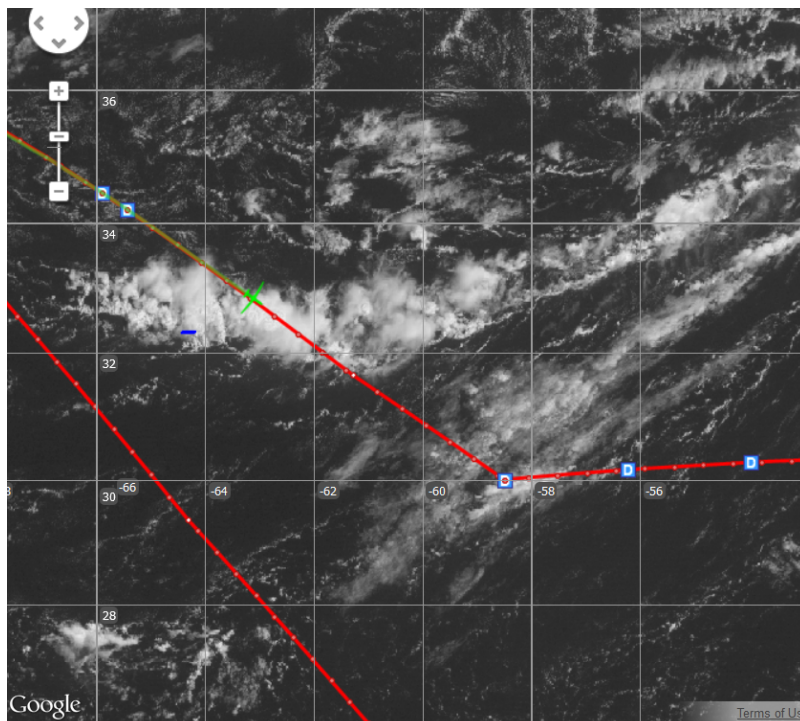
1437 Holding off on dropsonde until location D03.

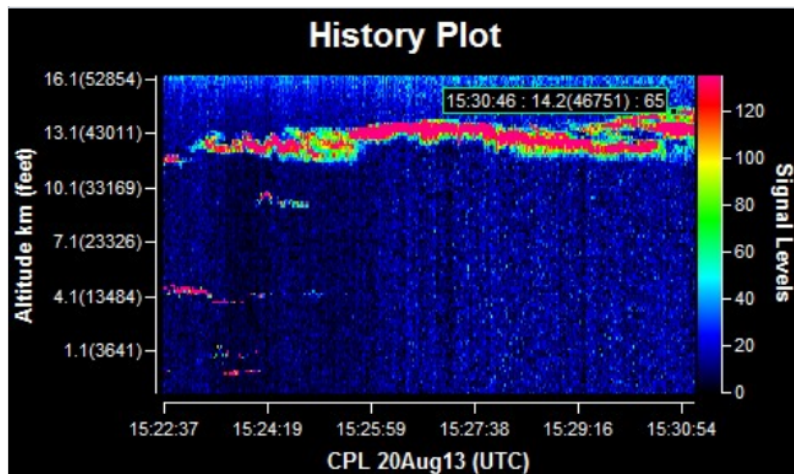
1455 Dropsonde release successful. Getting data.

1501 Second dropsonde released. Getting data. We will drop the two sondes later in the pattern on the north-south line segments on the eastern side of the lawnmower.

One lightning flash ahead associated with lower cloud tops <40 kft. CIMMS products shows cloud tops 44-46 kft (colored white) nearby and it would be hard to see lightning flashes in this height range. GH altitude is only 54kft, so it could be hard to detect lightning within 10kft for this cloud top height range. It would be useful to have the lightning colored in such a way that the lightning would be easier to see.

1525 Passing over area of convection. Sporadic lightning in the shallower cloud regions off nadir (>50 km). CPL showing cloud tops around 13-14 km.



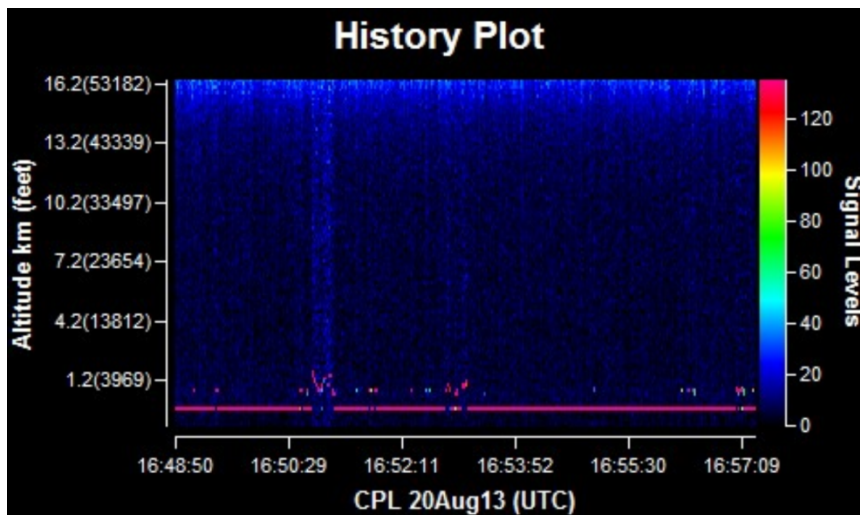


1549 Real-time avaps plots show that the data from the first two drops are good. Terry Hoch reporting some issues with first sonde, but may have been a fast fall. Good wind data all the way down.

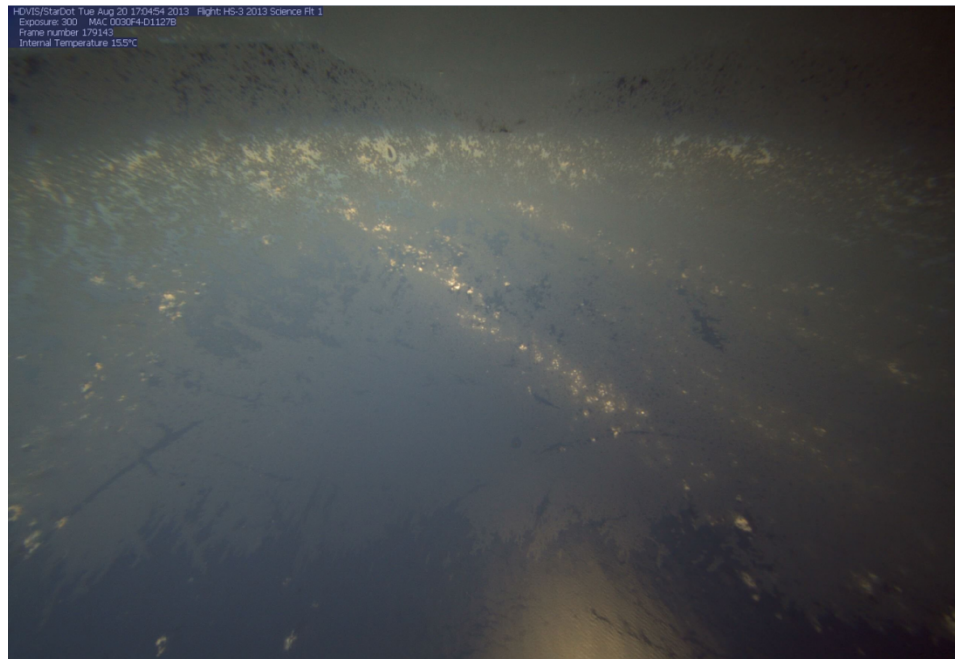
1609 Paul “The Man” Newman and Jeff Halverson taking over for Scott Braun and Anthony Didlake.

1619 Newman and Halverson in the GHOC-E. Sonde number 3 just released and operating.

1700 Flying over generally clear air. CPL showing only a few small low level clouds below AC.



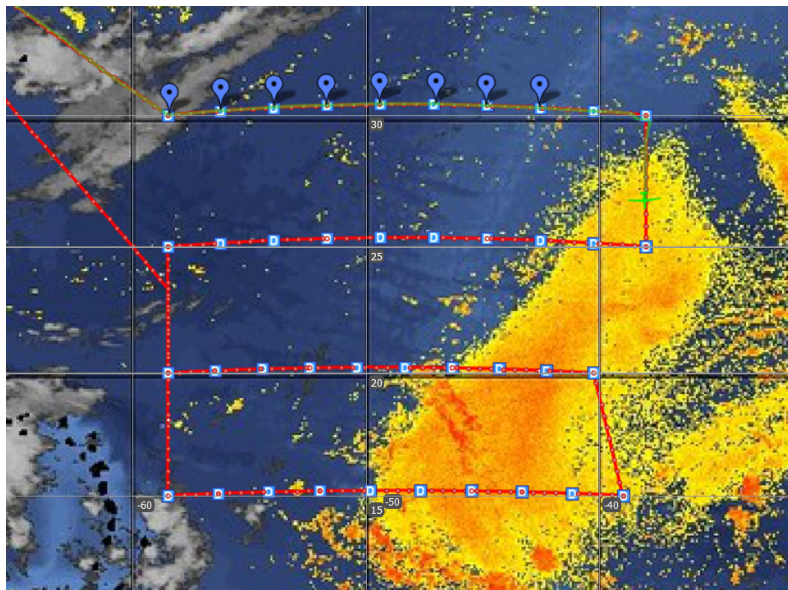
1705 HDVIS view showing the same clear air. Note once again the frost on the window of the



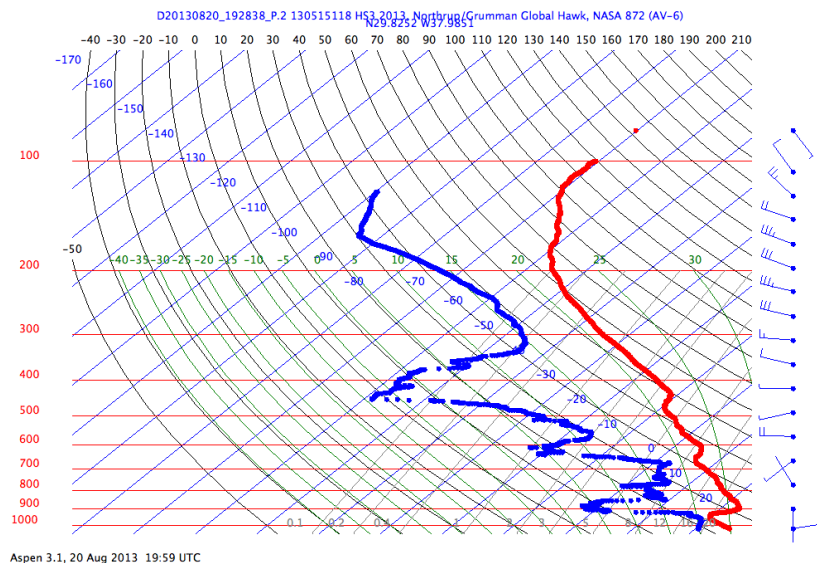
HDVIS camera.

1757 We are flying through some very clear air right now. CPL occasionally seeing a small cloud near the surface.

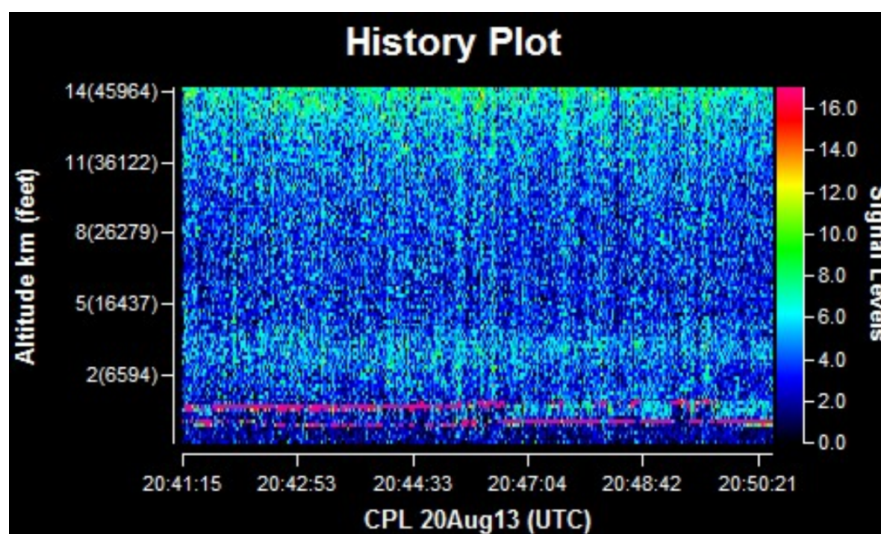
2000 After a fairly boring leg, it now appears that we're overflying some dry air. The image below shows the CIMSS SAL product valid at 18Z.



2015 The skew-T from AVAPS for the sonde in the NE corner of the path at 30N, 38W is below. Note the multiple inversions in the sonde.



2054 CPL shows a nice layer of dust at an altitude of about 3 km in the layer. Very dry in agreement with both scanning HIS retrieval and the dropsondes.



2100 Some problem with AVAPS communicating with their instrument.

2152 It turns out that EIP-2 has most probably failed. Since AVAPS is on EIP2, we won't have any dropsondes for the remainder of the flight. AVAPS stop reporting at 2047. Apparently in the middle of sonde 15.

2241 Small chance we can bring back AVAPS if we re-cycle the MPCS. There's a chance we might lose all, but the view is that it would be worth it.

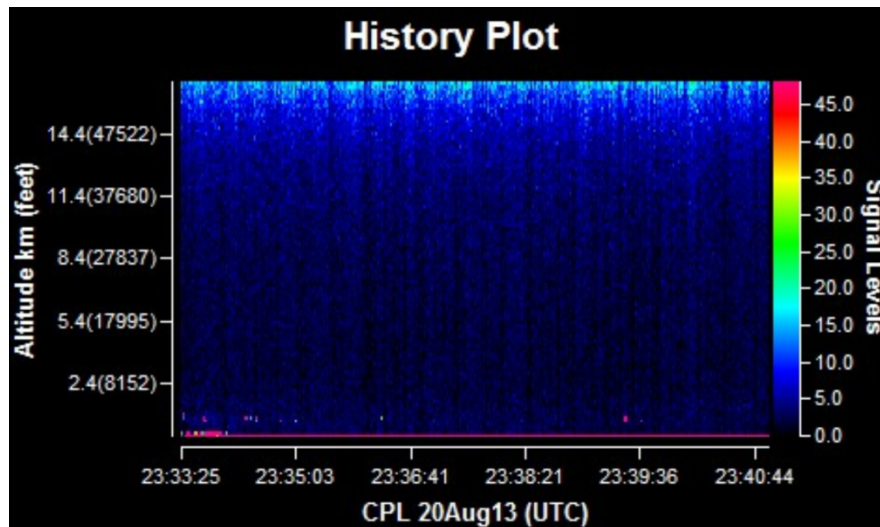
2242 Cycling the MPCS.

2250 Power off

2256 Power coming back up.

2307 Bringing payload back up. No luck on EIP-2.

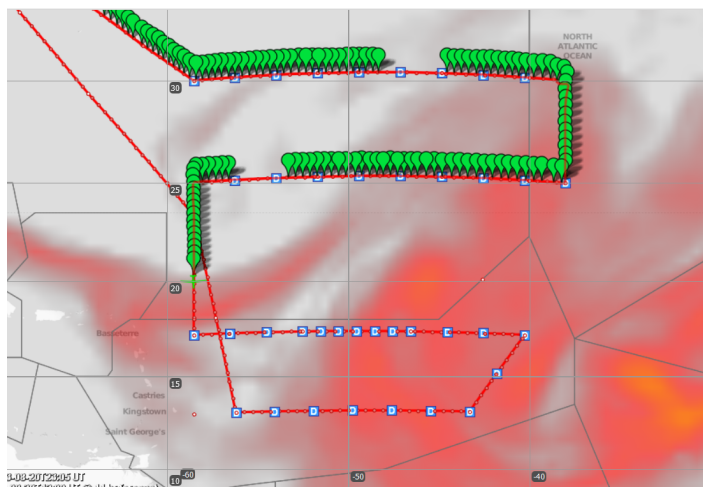
2344 Now on the way south from the 2nd E-W track to the 3rd. CPL still showing little cloud, and S-HIS showing very dry air.

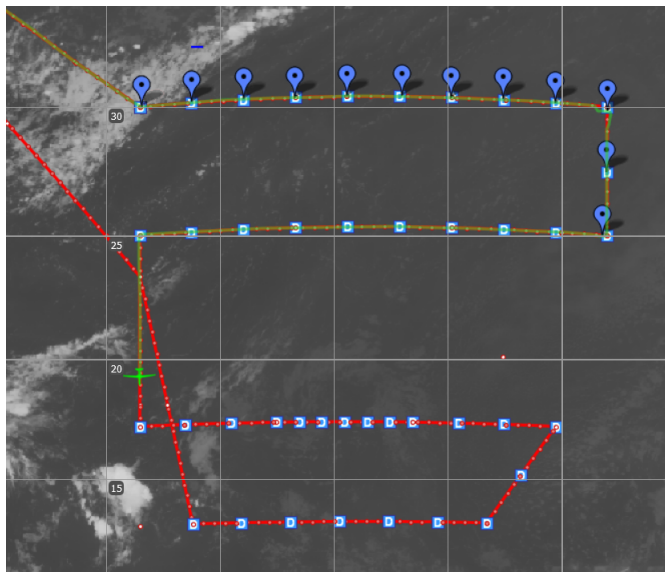
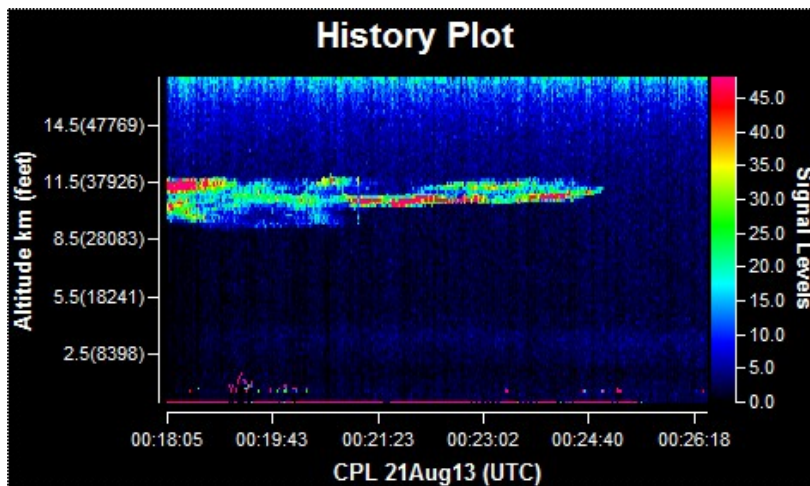


0000 Jon Zawislak, Steve Guimond and Dan Cecil takeover for Paul and Jason

0023 Approaching a potential SAL area (see below).

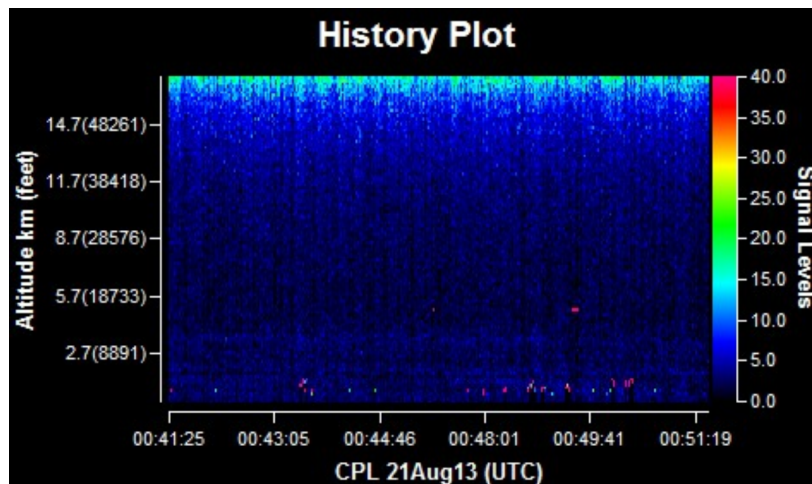
0026 CPL indicates cirrus 10-11.5 km as we approach that SAL air (see corresponding IR image below the CPL). The signal strength from CPL below the cloud layer is indicating some increase in a layer between 2.5-4.0 km which may be the apparent SAL layer that is forecasted to be to the west of ex-Erin.





0045 We have seen a light dust signal between 2.5-4.0 km. It's not as strong as it was in the northeast part of the pattern but seems to confirm the forecast of dust the east of ex-Erin.

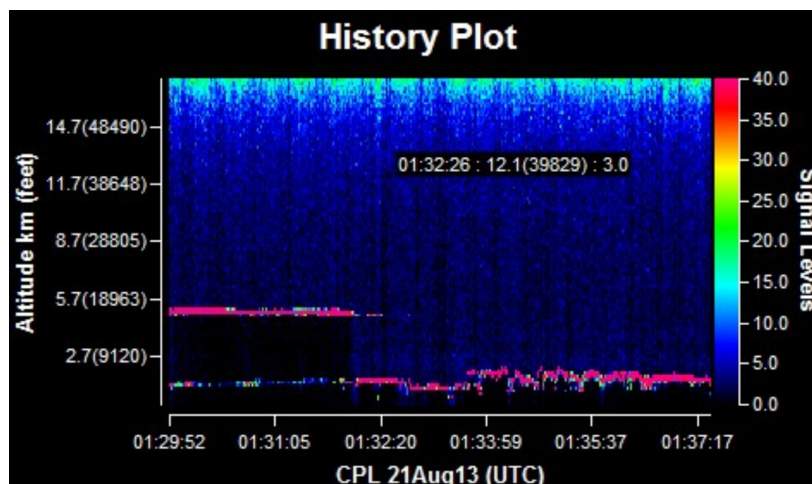
0050 Making turn into the 3rd east-west leg. CPL continues to indicate a light dust load between 2.5 and 4.0 km and is dissipating as we approach the turn into the next leg.

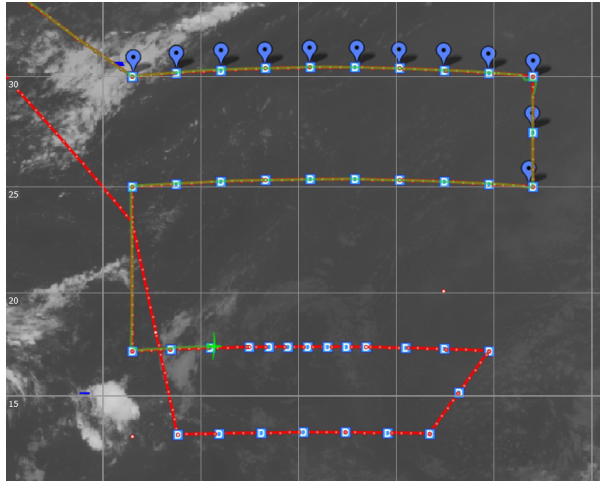


0100 The pilots notified us of an increased fuel burn and recommended that we change the plan by going from WP N06A to W07a which would cut off the eastern side of the pattern on both the 3rd and 4th east-west leg. This was not considered to be ideal since we would like to maximize the time in the SAL – particularly to get deeper to the east. They approved a change to continue to W06a then direct to N07a (middle point of the southern east-west leg) then direct to X06 and home. This way we will sample deeper into the SAL, still get farther south to compare the SAL structure on the 4th leg to the 3rd leg, and then resample the gradient into the clearer region. The return to X06 would also allow us to resample and cross closer to the center of ex-Erin and give us a better picture of the potential of dust near the circulation. We lose the lawnmower pattern, but without the drops, how useful would continuing the lawnmower be (perhaps assimilation of S-HIS retrieved soundings)?

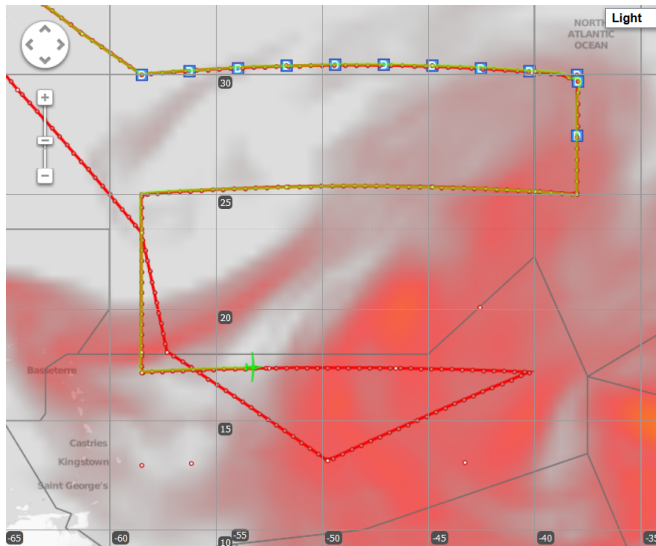
Only speculation on the reason for the higher fuel burn – winds aloft? Increased drag from the radome?

0138 CPL indicates a cloud deck topping out at 5.5 km which corresponds with the IR image. The deck lowers abruptly to 1.5 km as we approach the center of ex-Erin.

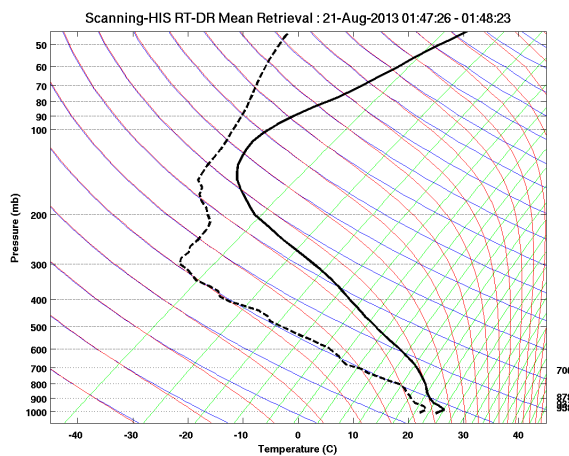
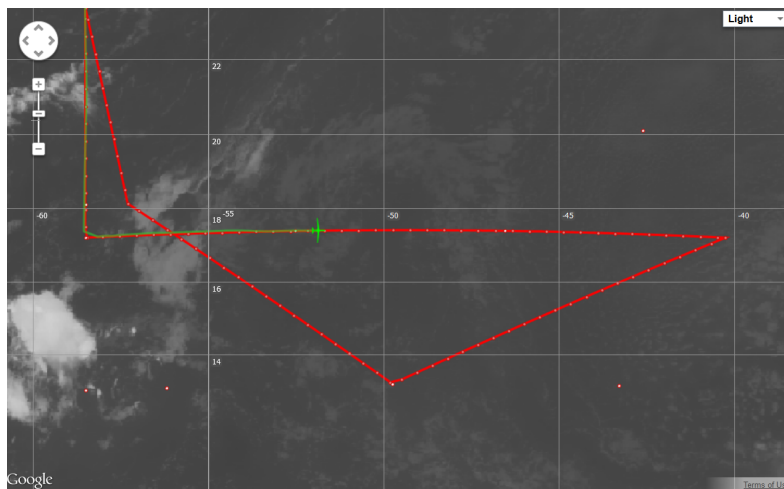
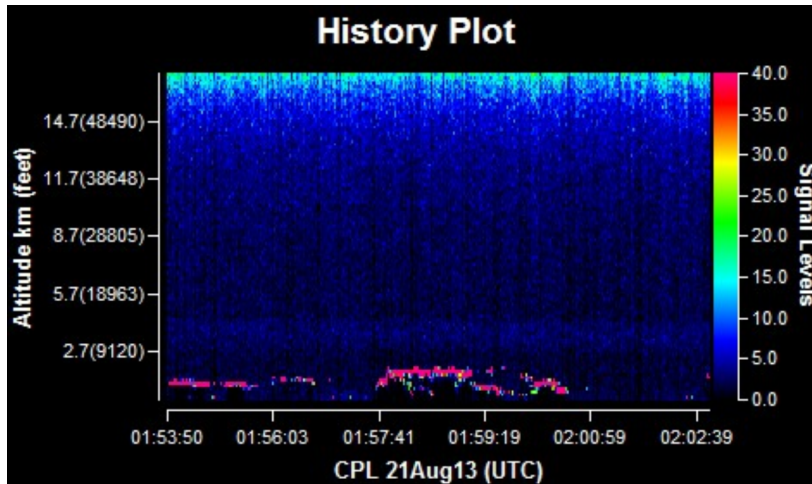




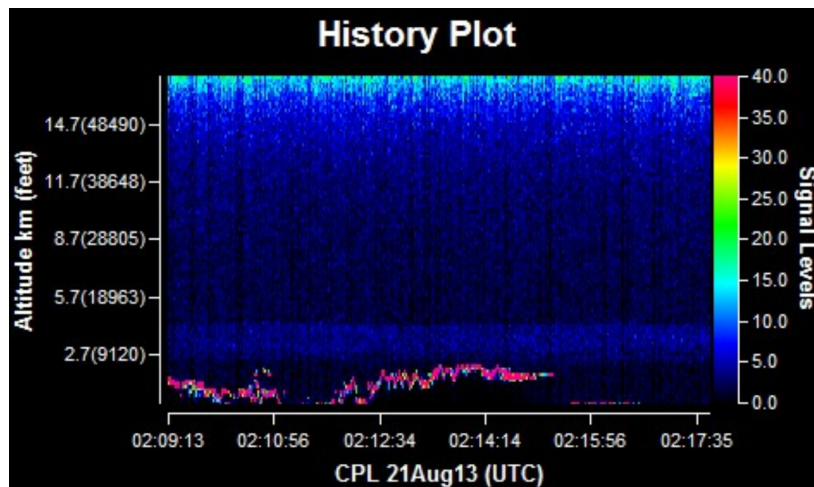
0150 Approaching the center of ex-Erin. IR indicates that we'll pass just to the south of the center but only by 20 nmi or so. The new flight path has been updated in MTS.



0202 As we are approaching the center of ex-Erin from the west side, CPL is indicating some boundary layer cloud below 2 km but a light dust layer approximately between 3 and 4 km (see CPL below). This indicates some dust exists on the west side of ex-Erin. The corresponding IR image is below. Thus far the GEOS-5 forecast (above) has corresponded well with CPL, however on this part of the leg the GEOS doesn't indicate dust on the western side of the circulation but CPL is. S-HIS retrieved sounding indicates strong inversion at the very near-surface – this profile has been fairly representative of the seen along much of this west to east leg.

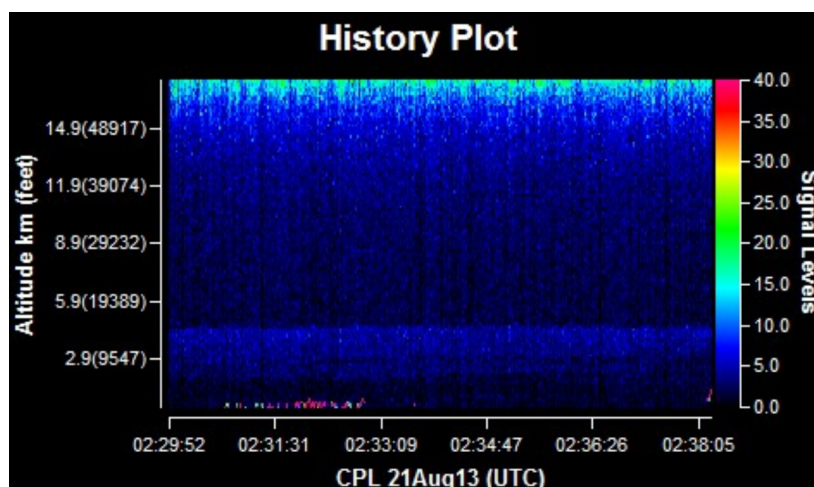


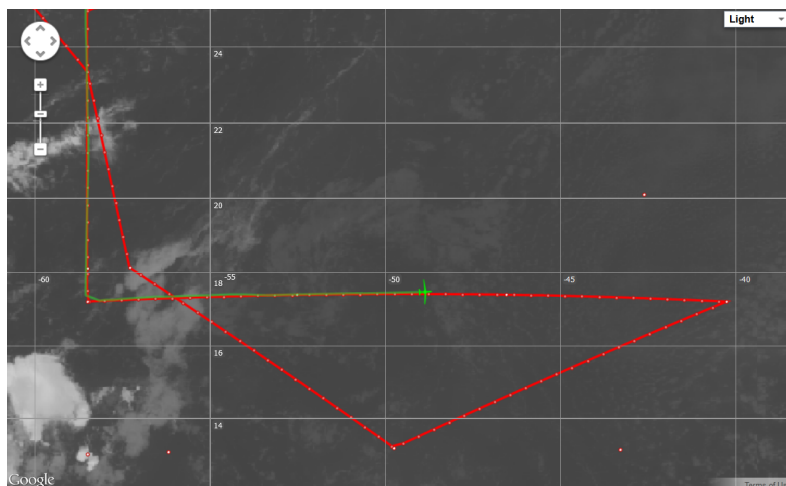
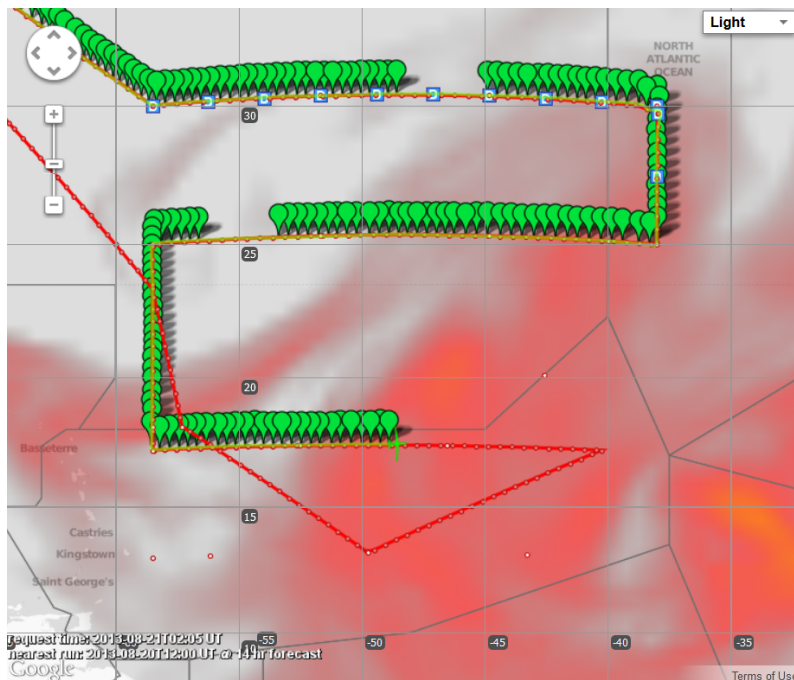
0218 We have crossed just south of the apparent ex-Erin center – at least that determined in the IR imagery (51W/17.7N). The CPL image below corresponds to the profile just to the west of the “center.” Light dust load between 2.5 and 4 km (approximate) is still observed with CPL.



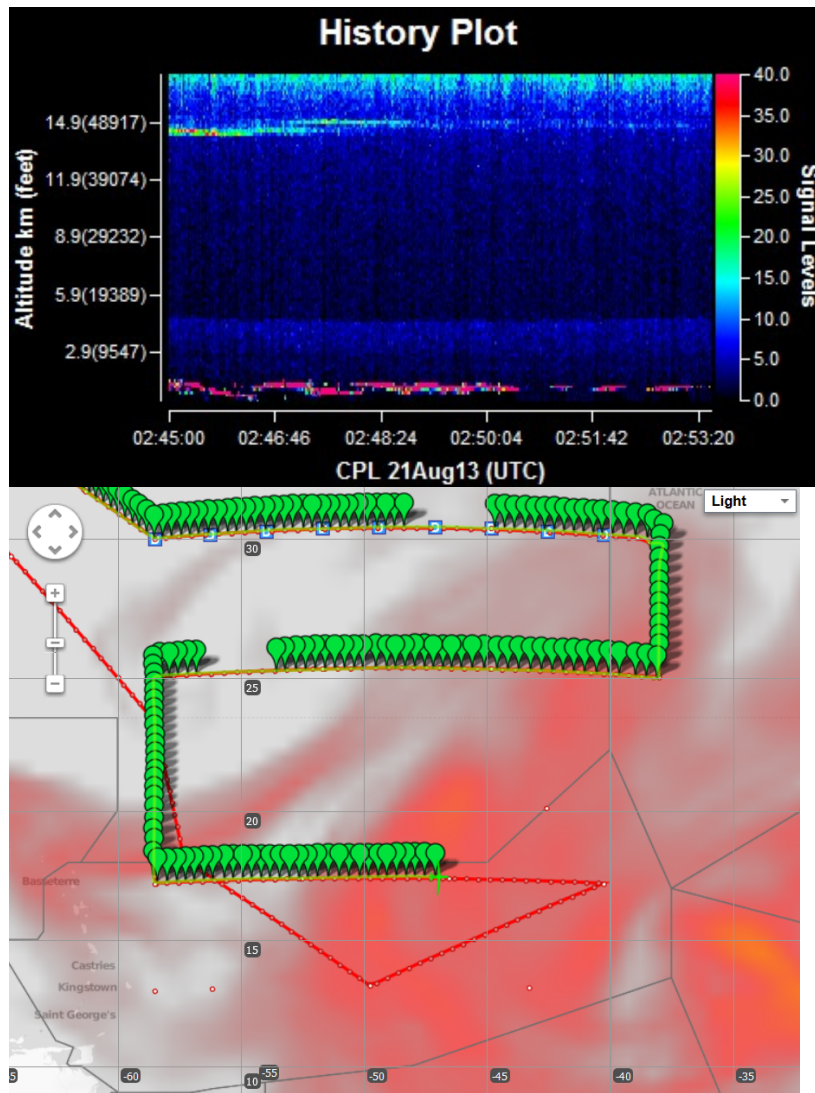
0230 Pilots are concerned about the ambient temperature for the fuel burn. They requested whether we'll see warmer temperatures in the pattern. After consulting with the forecasters, we don't expect large gradients in temperature in this pattern. The temperatures will warm some as we climb. The ambient temperature estimated by the forecasters was -50C (70 mb), the total temperature recorded by the GH is -55C, and the retrieved S-HIS is approximately -50C.

0239 Now on the eastern side of ex-Erin the thickness of the SAL has increased – now between 1.5 and 4.5 km. The layer has been pretty consistent overall along this leg. Whether there has been an increase in the dust load – which the forecast would indicate in this region – is unknown, but the backscatter hasn't changed.

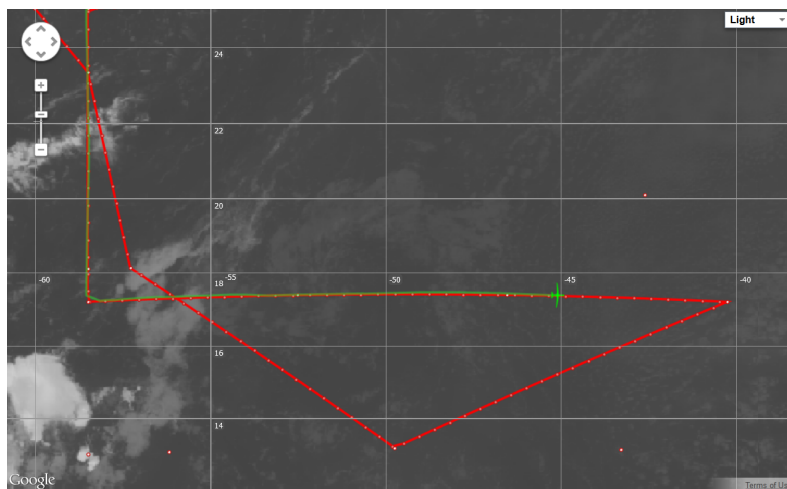
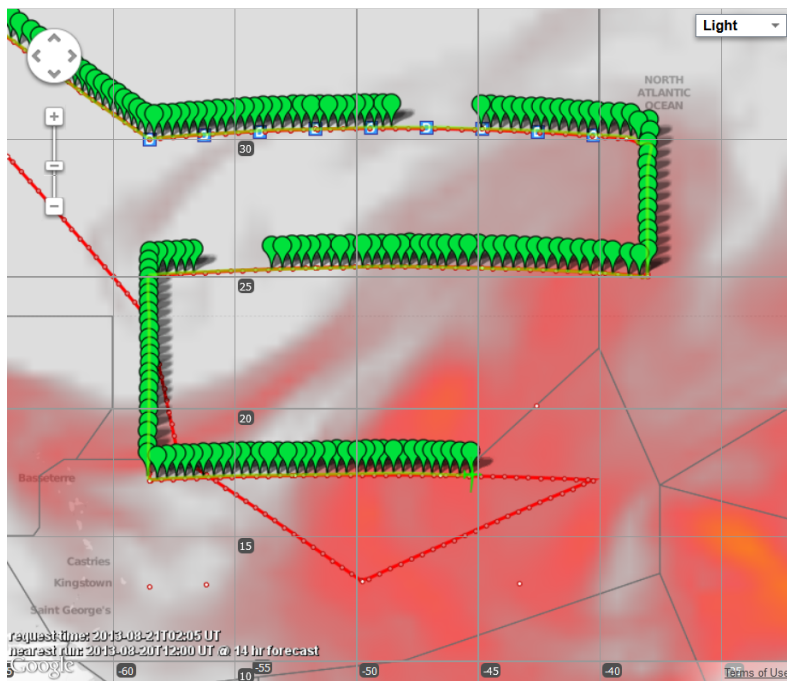
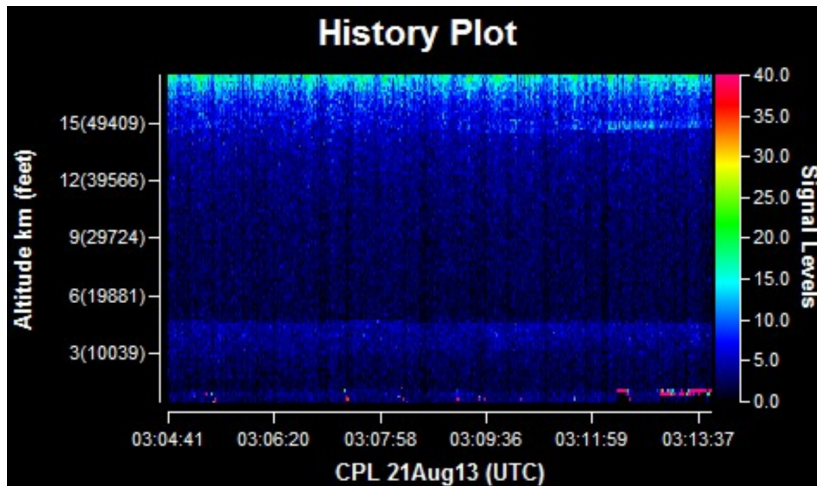




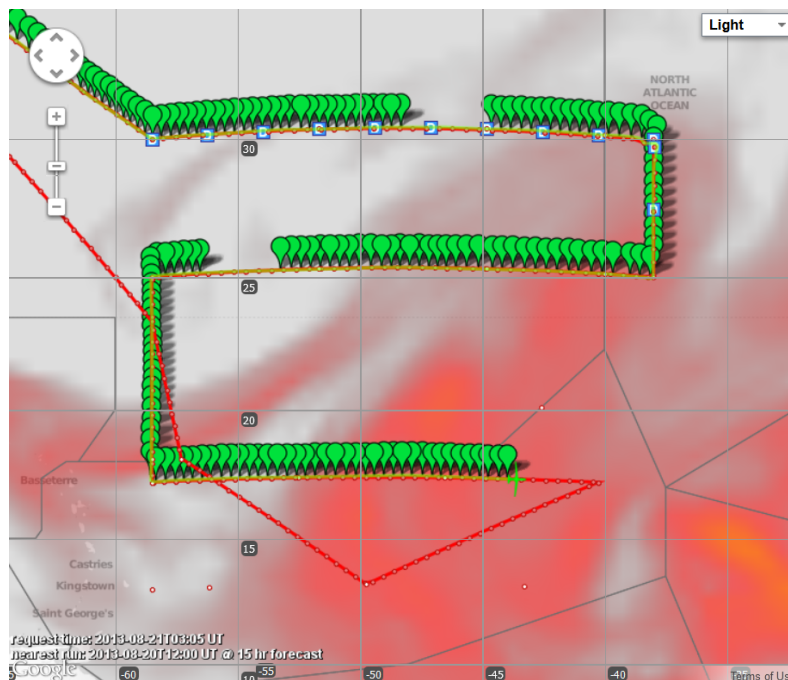
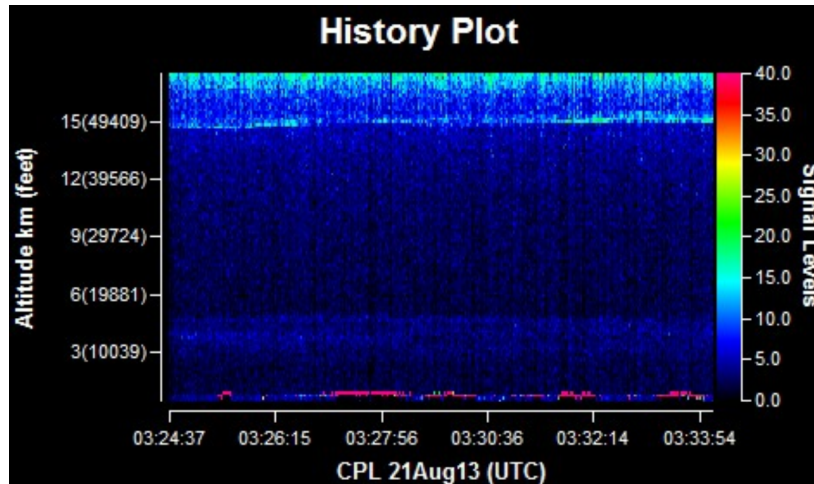
0300 We are now well into the forecasted SAL east of ex-Erin. CPL now indicates an even greater depth and even some undulations in the top of the layer. Boundary layer cloud below the near-surface inversion is still visible. We've also been discussing the GFS forecasted temperatures near flight level. Given that slight increases in temperature are expected, we relayed this information to the pilots to ease their concerns some.



0315 The layer remains visible in CPL (below), however the signal has not increased so it is difficult to determine whether there has been any change in concentration. The top of the layer appears to be just above 4.5 km and the strongest signal extends down to about 3 km (but possibly light dust loads lower). There is also a stronger signal in the boundary layer (interspersed with cloud) than was observed earlier on in the legs.

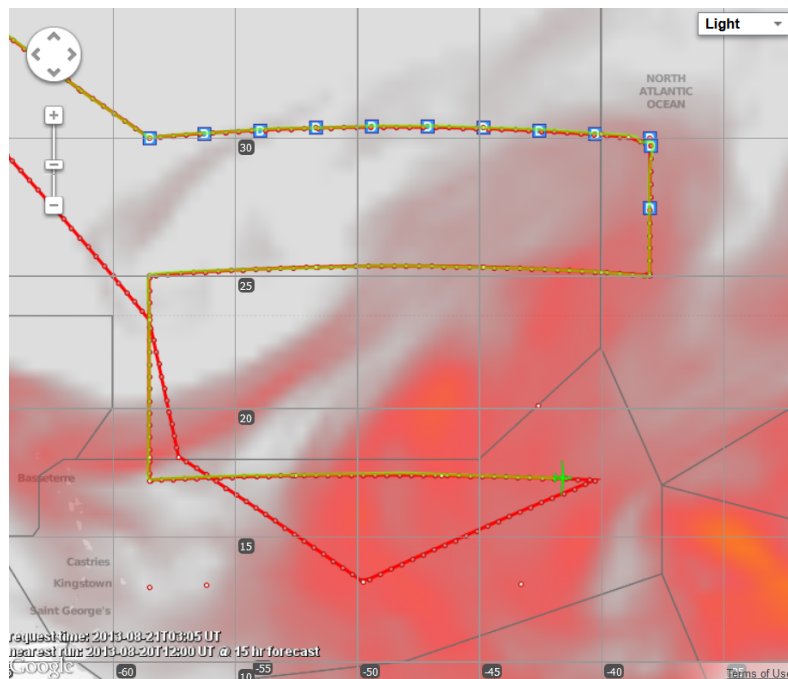
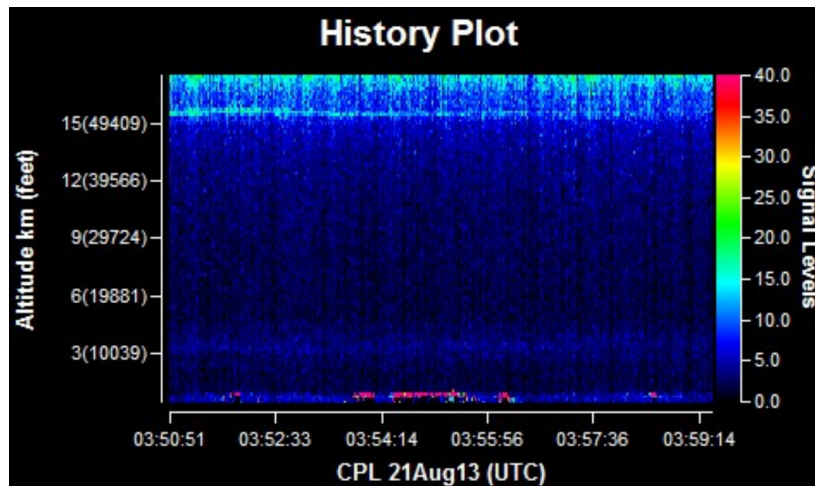


0335 The layer characteristics have changed as we've approached the far eastern part of this 3rd leg. The depth of the layer hasn't changed much but perhaps the concentration has changed some. The layer certainly does not look as impressive as when we were closer to ex-Erin's center.

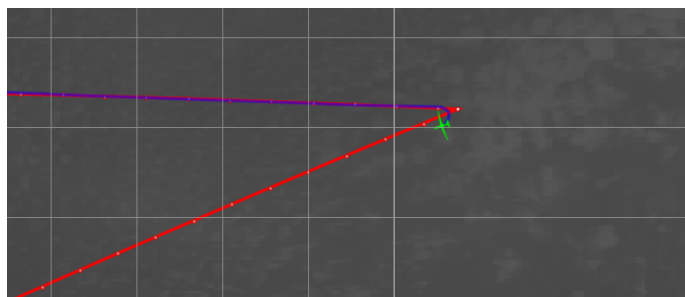
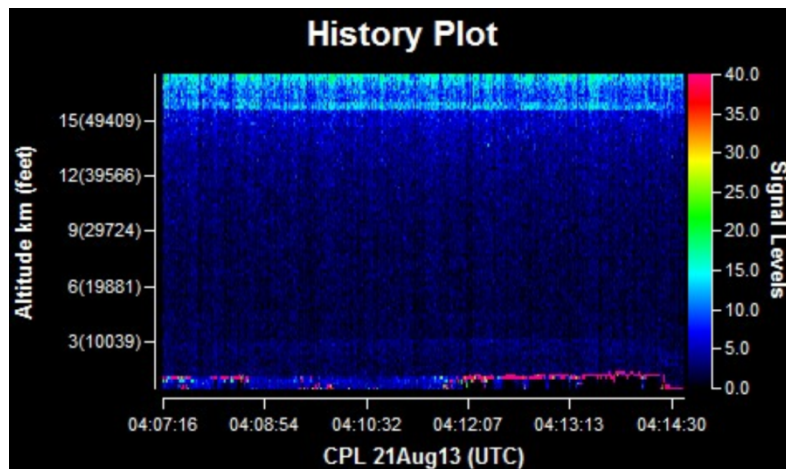


0345 The layer between 3.5 and 4 km has become better defined again as we approach the turn from the 3rd leg to the 4th.

0400 Approaching the end of the west to east leg. CPL indicates another thinning of the layer. Overall along the leg, we've seen elevated dust to the west of ex-Erin, the greatest apparent depth (and possibly concentration) just east of ex-Erin, and some variability through the remainder of the leg farther east of ex-Erin.

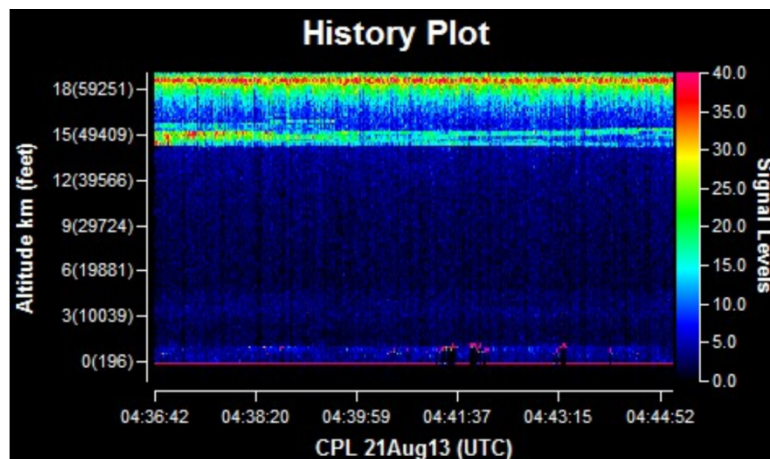


0415 Making the turn at WP W06a. The layer has thinned even more now (CPL image below). CPL also indicates more persistent PBL cloud and the IR image possibly confirms that change.

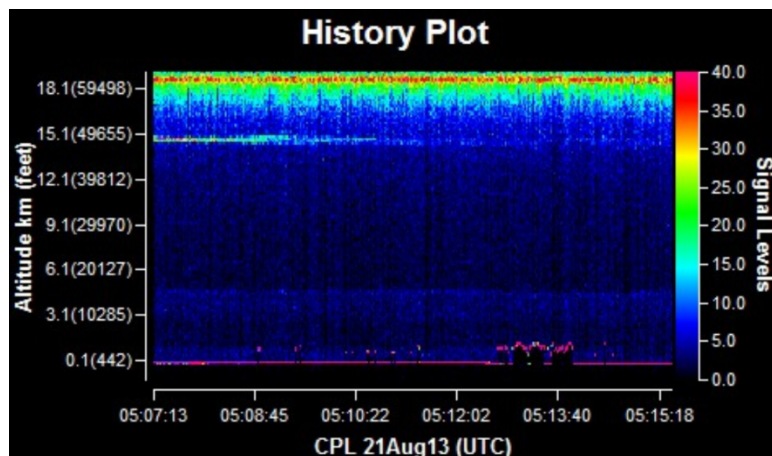


0433 Pilots have decided they can continue from waypoint “N07a” to waypoint “N08a” instead of going directly to waypoint “X06”. This will give us the rest of the southernmost cross section of the SAL.

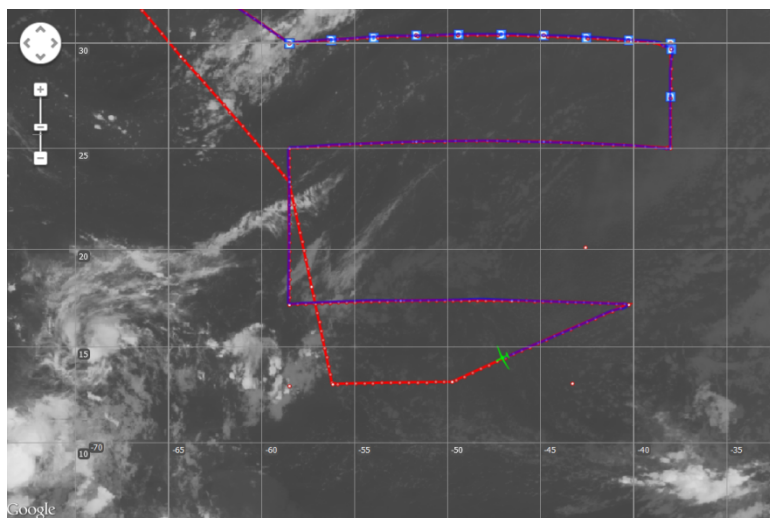
0450 Update from CPL, several things to note in the figure below... (1) cirrus layer at ~ 15 km altitude (not too thick so signal not attenuating), (2) dust/SAL layer around 3 – 4 km altitude and (3) boundary layer structure below the dust. This is on the SW transect.



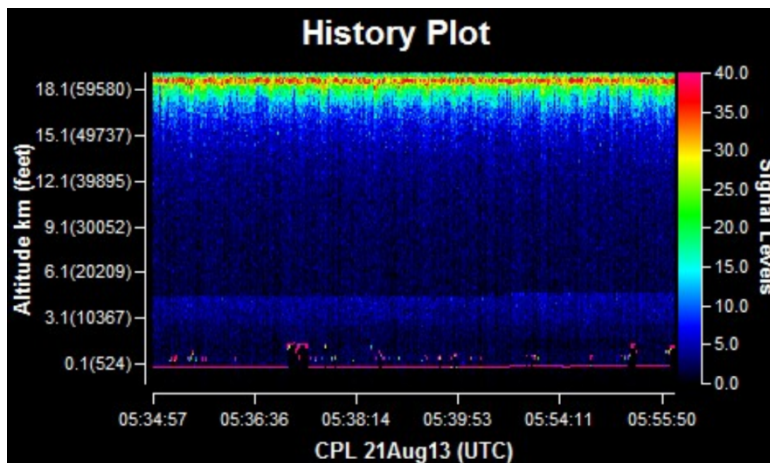
0520 another update on CPL imagery...cirrus is thinning out but dust layer around 3 – 4 km altitude is still present as well as the boundary layer.



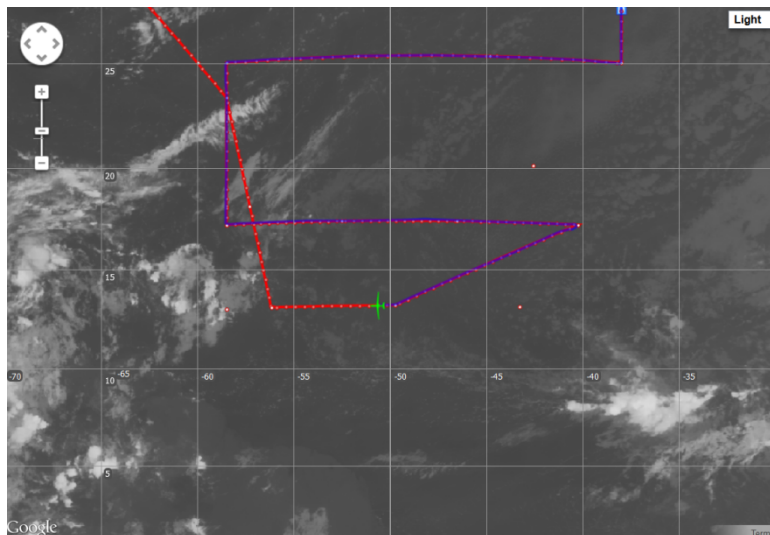
0525 Below is the current position of the aircraft and the extension of the track to N08a. Should be some more action on the leg back home with more clouds and a frontal system to pass over.



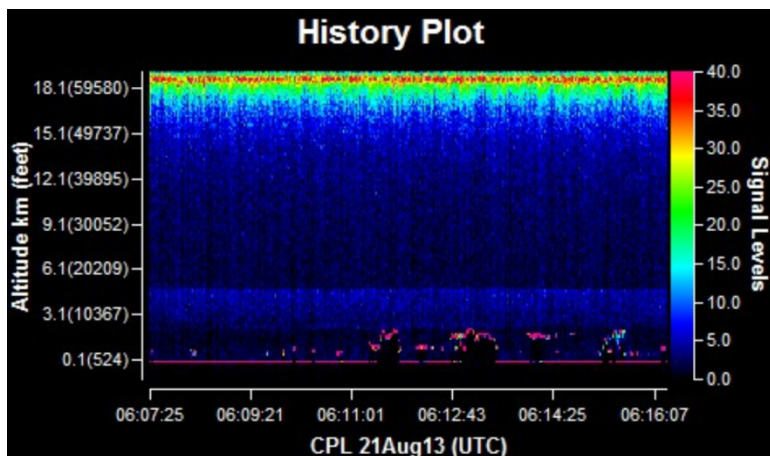
0600 CPL update below...cirrus clouds have disappeared but dust/SAL layer is still hanging on.



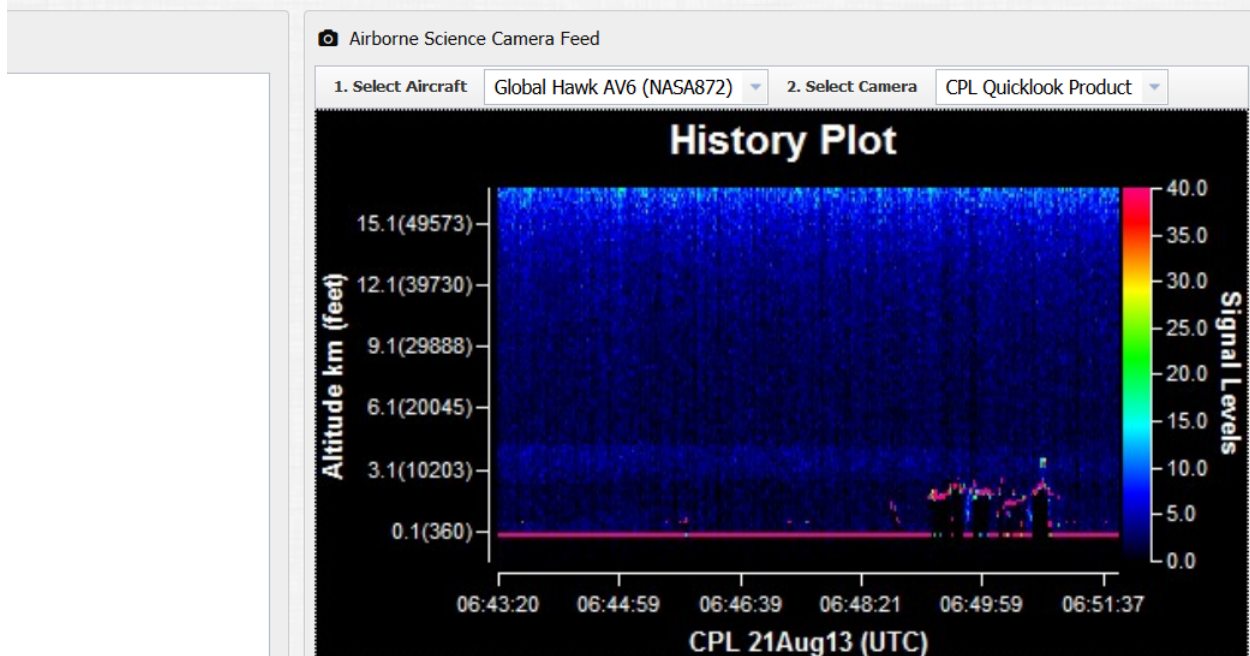
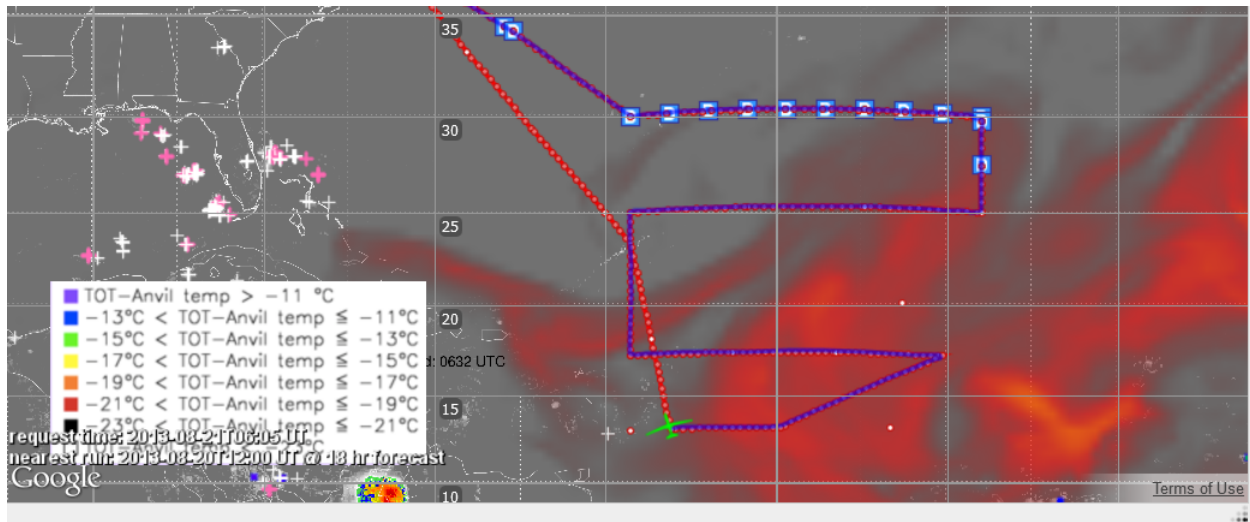
0600 We are heading west now for our final short leg before heading home. Dust/SAL has been consistent throughout the last few legs, will be interesting to see where the Western edge of the SAL is located.



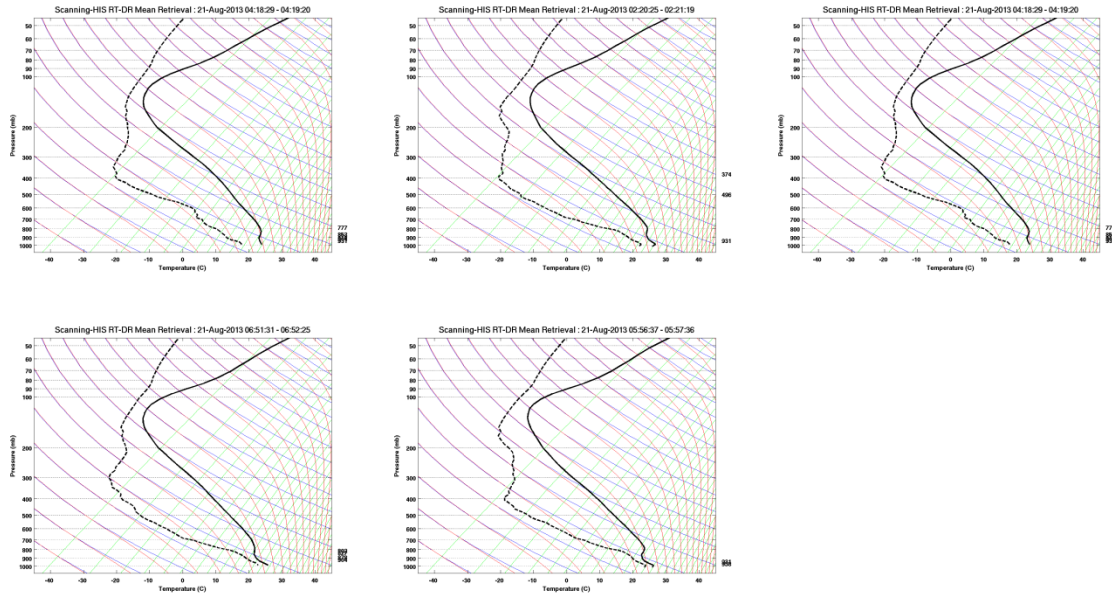
0620 CPL image still showing dust, but no clouds.



The southernmost leg was completed about 0655 UTC, with the backscatter for the dust layer in CPL decreasing from east to west.



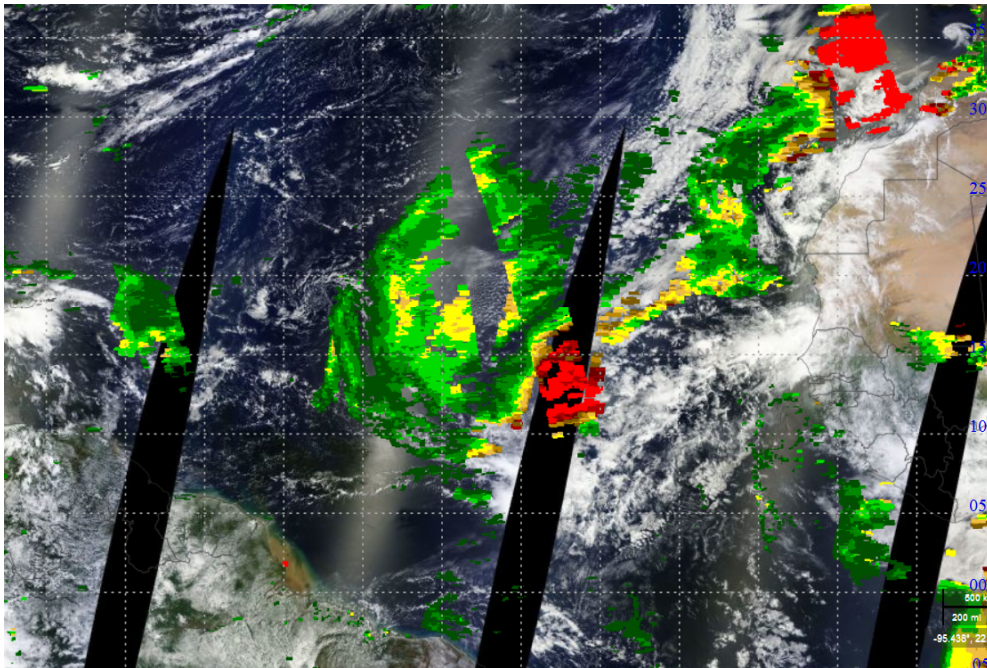
SHIS indicates much drier air at low levels on the W-E leg along 17.5 N than on the southernmost E-W leg along 13.2 N:



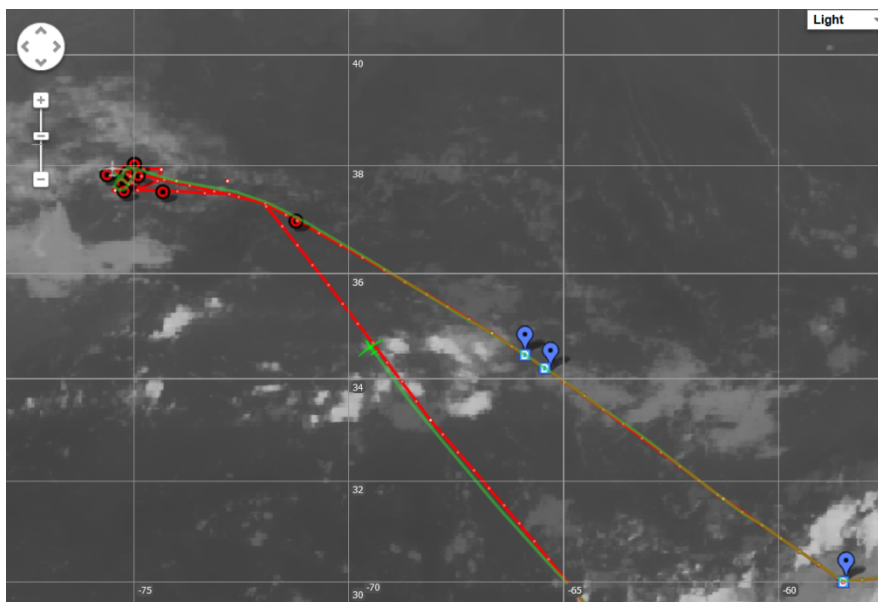
Sequence of SHIS retrievals at (first row) 17.4 N, 55.8 W; 17.4 N, 50.5 W; 17 N, 40.6 W;
(second row) 13.1 N , 55.9 W; 13.2 N, 50.2 W.

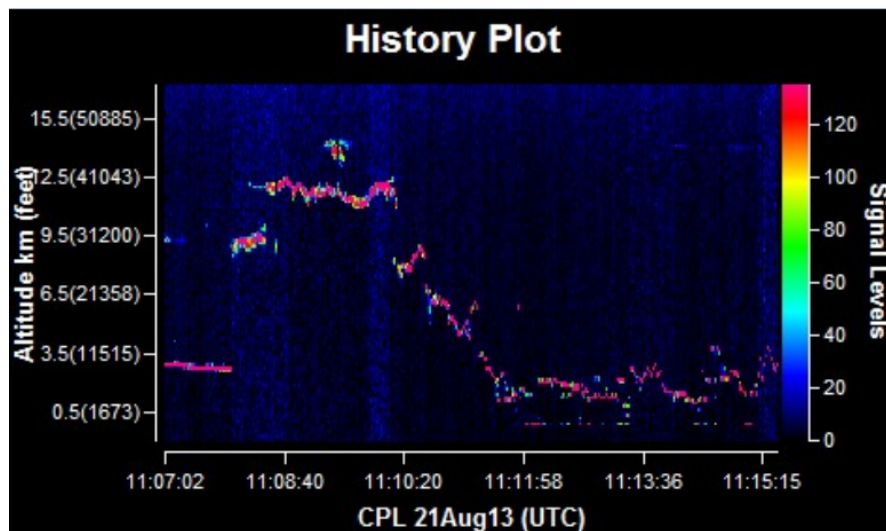
0846 Scott Braun and Anthony Didlake taking over as MS.

Below is the MODIS AOD for Aug 20 (afternoon). It shows the leading edge of the dust overtaking the eastern side of ex-Erin by mid-day. CPL observations suggest that the dust may have completely overrun Erin at later times. AODs are not that impressive (~ 0.3 - 0.45) in the region east of Erin. Much higher dust concentrations north of Pouch 23L to the southeast of Erin.



1120 On the ferry flight back to Wallops, we passed several clouds. CPL observations show cloud tops reaching between 9-13 km. These clouds showed no signal on the TOT product and had no lightning in them.





1130 Scott Braun gracefully leaves the helm. Amber Emory and Anthony Didlake take over as MS.

1223 Instruments begin shut down for descent.

1228 Initial descent to FL450 begins.

1240 Instruments begin turning on again.

1258 Final descent begins.

1312 Iridium links were lost during final shutdown and are having trouble coming back up.

1323 Payloads are down, landing gear is deployed.

1334 Performed a missed approach maneuver.

1346 Aircraft lands.

Location	Dro p #	Comment	Actual Time (UTC)	Originally Planned Time (UTC)	Elapse d	Lon.	Lat.
				hh mm.m	(hrs)		
D01		Sonde loaded, but air traffic		. 12 28.0	1.47	W06851.000	N3555.99 8
D02				. 12 32.7	1.55	W06822.998	N3543.00 2

D03	01	Successful release	1455	. 12 58.5	1.98	W06554.000	N3427.000
D04	02	Successful release	1501	. 13 3.5	2.06	W06525.997	N3412.000
D05	03	Successful release	1618	. 14 22.0	3.37	W05830.000	N3000.000
D06	04	Successful release	1638	. 14 43.2	3.72	W05613.848	N3009.474
D07	05	Successful release	1700	. 15 4.4	4.07	W05357.307	N3016.602
D08	06	Successful release	1721	. 15 25.6	4.43	W05140.494	N3021.360
D09	07	Successful release	1742	. 15 46.8	4.78	W04923.520	N3023.748
D10	08	Successful release	1804	. 16 7.9	5.13	W04706.480	N3023.748
D11	09	Successful release	1825	. 16 29.1	5.49	W04449.506	N3021.360
D12	10	Successful release	1845	. 16 50.3	5.84	W04232.693	N3016.602
D13	11	Successful release	1906	. 17 11.5	6.19	W04016.152	N3009.474
D14	12	Successful release	1928	. 17 34.4	6.57	W03800.000	N3000.000
D14.5	13	Added sonde launch from missed sonde on transit	1954			W03800.000	N2730.000

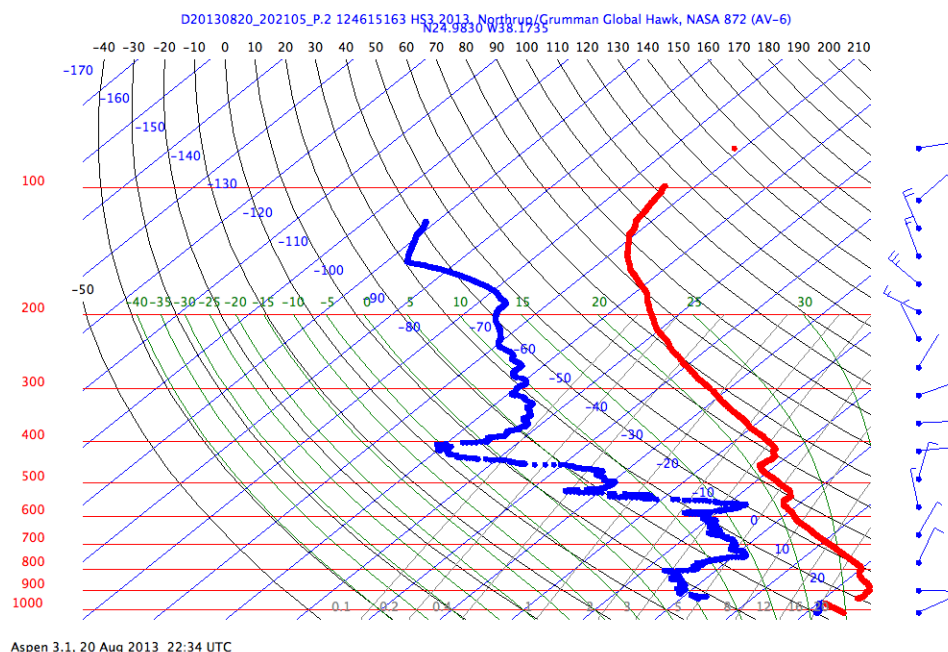
D15	14	Successful release	2021	. 18 30.1	7.5	W03800.000	N2500.000
D16	15	Successful release	2041	. 18 52.3	7.87	W04016.302	N2508.394
D17		Sonde not loaded. Problem with EIP power	_	. 19 14.4	8.24	W04232.875	N2514.706
D18		Problem continues	_	. 19 36.6	8.61	W04449.644	N2518.918
D19		No further sonde launches	_	. 19 58.8	8.98	W04706.533	N2521.030
D20		_	_	. 20 21.0	9.35	W04923.467	N2521.030
D21		_	_	. 20 43.2	9.72	W05140.356	N2518.918
D22		_	_	. 21 5.3	10.09	W05357.120	N2514.706
D23		_	_	. 21 27.5	10.46	W05613.698	N2508.394
D24		_	_	. 21 51.4	10.86	W05830.000	N2500.000
D25		_	_	. 22 47.1	11.78	W05830.000	N2000.000
D26		_	_	. 23 7.6	12.13	W05628.500	N2005.580
D27		_	_	. 23 28.1	12.47	W05426.880	N2009.768

D28		—	—	. 23 48.5	12.81	W05225.164	N2012.56 4
D29		—	—	. 00 9.0	13.15	W05023.394	N2013.96 8
D30		—	—	. 00 29.5	13.49	W04821.606	N2013.96 8
D31		—	—	. 00 50.0	13.83	W04619.836	N2012.56 4
D32		—	—	. 01 10.4	14.17	W04418.120	N2009.76 8
D33		—	—	. 01 30.9	14.52	W04216.500	N2005.58 0
D34		—	—	. 01 52.9	14.88	W04015.000	N2000.00 0
D35		—	—	. 02 50.3	15.84	W03900.000	N1500.00 0
D36		—	—	. 03 12.8	16.21	W04109.882	N1504.96 2
D37		—	—	. 03 35.3	16.59	W04319.854	N1508.69 4
D38		—	—	. 03 57.8	16.96	W04529.879	N1511.18 4
D39		—	—	. 04 20.3	17.34	W04739.961	N1512.42 6
D40		—	—	. 04 42.8	17.71	W04950.039	N1512.42 6
D41		—	—	. 05 5.3	18.09	W05200.121	N1511.18 4
D42		—	—	. 05 27.8	18.46	W05410.146	

							N1508.69 4
D43		_	_	. 05 50.3	18.84	W05620.118	N1504.96 2
D44		_	_	. 06 14.7	19.24	W05830.000	N1500.00 0

AVAPS Status 20130820 Flight

44 sondes were loaded for the flight and ultimately 15 were deployed. AVAPS performed very well through the initial portion of the flight until a power issue associated with EIP 2 caused loss of power to the data system. Telemetry from the soundings appeared improved from last year and data was returned to the surface but we would like to see the results from a greater number of sondes before concluding whether the issue has been resolved. There were some telemetry dropouts from the first sounding, but it was a fast fall which may have been a factor. Complete soundings were returned from the first 14 sondes but power was lost during the middle of the 15th drop. The attached graphic is the skew-T plot from the 14th sounding (drop location 15) which took place in the middle of elevated SAL concentrations.



CPL performed nominally during the 20-21Aug13 Science flight. Laser energies, laser 532 signal strength, and temperatures were all very good. We won't be able to tell if the 1064 parallel channel is fixed until we download the data, but all indications during a hanger test on Monday showed the channel responding. We did sense the SAL dust layer on multiple occasions

S-HIS summary

Nominal operation. No problems encountered. Real-time retrievals available on MTS.

S-HIS Quicklook BT Map for flight 20130820 at 11 microns ($985-905\text{ cm}^{-1}$)

